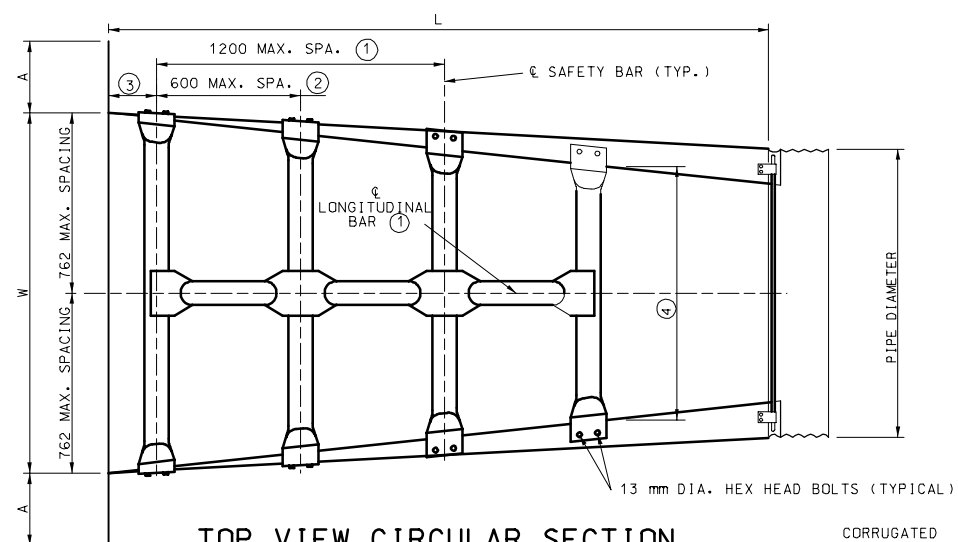


SIDE ELEVATION CIRCULAR SECTION

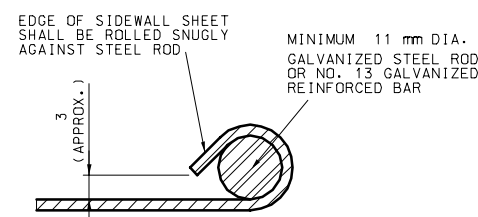
- ① FOR CROSSROAD DRAINAGE STRUCTURES ONLY.
- ② FOR PARALLEL DRAINAGE STRUCTURES ONLY.
- ③ 100 mm TO 150 mm MINIMUM
- ④ SAFETY BARS SHALL BE PROVIDED UNTIL THE LATERAL SPAN OF THE OPENING IS LESS THAN OR EQUAL TO 750 mm.



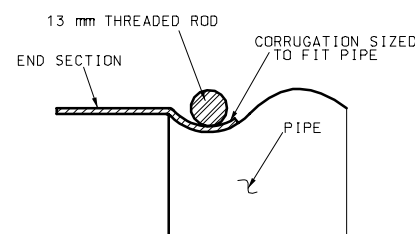
TOP VIEW CIRCULAR SECTION

LONGITUDINAL BAR, WHEN REQUIRED, SHALL BE WELDED TO SAFETY BARS TO FORM SINGLE GRATE STRUCTURE. LONGITUDINAL BAR IS NOT TO BE USED FOR PARALLEL DRAINAGE STRUCTURES.

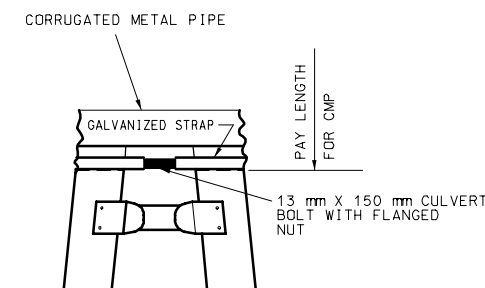
SAFETY BARS SHALL BE USED ON CROSSROAD DRAINAGE STRUCTURES WHEN LONGITUDINAL BAR IS SPECIFIED.



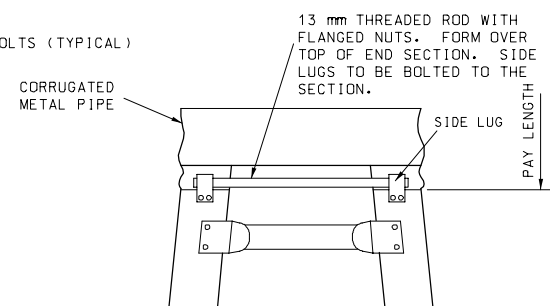
SECTION A-A



SECTION B-B



FOR 375 mm THRU 600 mm PIPE
TYPE #1 CONNECTOR
DETAIL



FOR 750 mm AND LARGER ROUND PIPES
TYPE #2 CONNECTOR DETAIL

METAL END SECTIONS FOR CIRCULAR PIPES												
PIPE DIA. mm	MIN. THICKNESS ENDS (mm) 1:4 & 1:6	MIN. THICKNESS ENDS (mm) 1:10	DIMENSIONS IN mm				L DIMENSIONS					
			A 25 mm TOL.	H 25 mm TOL.	W 50 mm TOL.	OVERALL WIDTH	SLOPE	LENGTH mm	SLOPE	LENGTH mm	SLOPE	LENGTH mm
375 ***	1.6	2.7	200	150	525	925	1:4	500	1:6	750	1:10	1750
450 ***	1.6	2.7	200	150	600	1000	1:4	800	1:6	1200	1:10	2500
525 ***	1.6	2.7	200	150	675	1075	1:4	1100	1:6	1650	1:10	3250
600	1.6	2.7	200	150	750	1150	1:4	1400	1:6	2100	1:10	4000
750	2.7		300	225	900	1500	1:4	2000	1:6	3000		
900	2.7		300	225	1050	1650	1:4	2600	1:6	3900		
1050	2.7		400	300	1200	2000	1:4	3200	1:6	4800		
1200	2.7		400	300	1350	2150	1:4	3800	1:6	5700		
1350	2.7		400	300	1500	2300	1:4	4400	1:6	6600		
1500	2.7		400	300	1650	2450	1:4	5000	1:6	7500		

*** NO SAFETY SLOPE END SECTION REQUIRED FOR SINGLE PIPE INSTALLATION
WITH PIPES 525 mm DIAMETER OR LESS.

GENERAL NOTES:

ALL DIMENSIONS SHOWN ARE IN mm UNLESS NOTED.

END SECTIONS INCLUDING ALL BOLTS, NUTS, RODS AND STRAPS SHALL BE FABRICATED FROM GALVANIZED STEEL MEETING THE REQUIREMENTS OF SECTION 1020 THE STANDARD SPECIFICATIONS.

ALL BOLTS UNLESS OTHERWISE SHOWN SHALL BE A307 BOLTS.

WHEN REQUIRED, OPTIONAL TOE PLATE EXTENSION SHALL BE PUNCHED OR DRILLED AND BOLTED TO END SECTION TOE PLATE, STEEL FOR TOE PLATE EXTENSION SHALL BE SAME GAUGE AS END SECTION. DIMENSIONS SHALL BE OVERALL WIDTH LESS 150 mm BY 200 mm HIGH.

ATTACHMENT TO CIRCULAR PIPES 375 mm THROUGH 600 mm DIAMETER SHALL BE MADE WITH TYPE #1 STRAPS. ALL OTHER SIZES SHALL BE ATTACHED WITH TYPE #2 CONNECTORS.

SAFETY BARS AND LONGITUDINAL BARS SHALL BE FABRICATED FROM STEEL PIPE MEETING THE REQUIREMENTS OF ASTM A-53 SCHEDULE 40 SPECIFICATIONS. SAFETY BARS AND LONGITUDINAL BARS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH SECTION 1020 OF STANDARD SPECIFICATIONS.

INSTALLATION SHALL BE PERFORMED IN ACCORDANCE WITH SECTION 725 AND 732 OF THE STANDARD SPECIFICATIONS.

SLOTTED HOLES FOR SAFETY BAR ATTACHMENT SHALL BE PROVIDED FOR ALL END SECTIONS.

MINOR VARIATIONS OF DETAIL WILL BE ACCEPTED TO PERMIT THE USE OF A MANUFACTURER'S STANDARD METHODS OF FABRICATION.

END SECTIONS FABRICATED FROM THICKER METAL THAN INDICATED WILL BE ACCEPTED.

SAFETY BARS ARE OPTIONAL FOR PIPES WITH DIAMETERS OF LESS THAN 525 mm.

ALL PIPES WITH DIAMETERS GREATER THAN 525 mm CONSTRUCTED WITHIN THE 1:10 APPROACH SLOPE OF ANY BULLNOSE GUARDRAIL SYSTEM SHALL HAVE SAFETY SLOPE END SECTION PROTECTION.

ALL BOLTS SHALL BE 10 mm DIAMETER AND GALVANIZED, UNLESS OTHERWISE SHOWN.

SKIRT SECTION IS DEFINED AS THE FLARED PORTION OF THE END SECTION INCLUDING SIDE AND BOTTOM (CENTER) PANELS AND APRON.

SKIRT SECTION FOR 300 mm TROUGH 600 mm PIPES SHALL BE MADE IN ONE PIECE.

SKIRT SECTIONS FOR 750 mm AND LARGER PIPES MAY BE MADE FROM UP TO 2 SHEETS JOINED BY RIVETING OR BOLTING ON CENTERLINE.

SKIRT SECTIONS FROM 1200 mm AND LARGER PIPES MAY BE MADE FROM UP TO 3 SHEETS JOINED BY RIVETING OR BOLTING EQUAL DISTANCE FROM CENTERLINE.

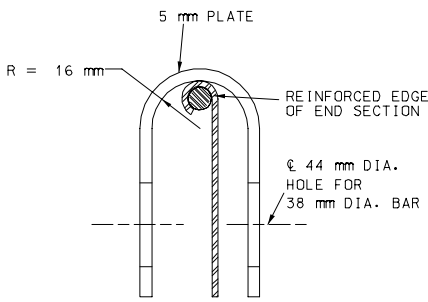
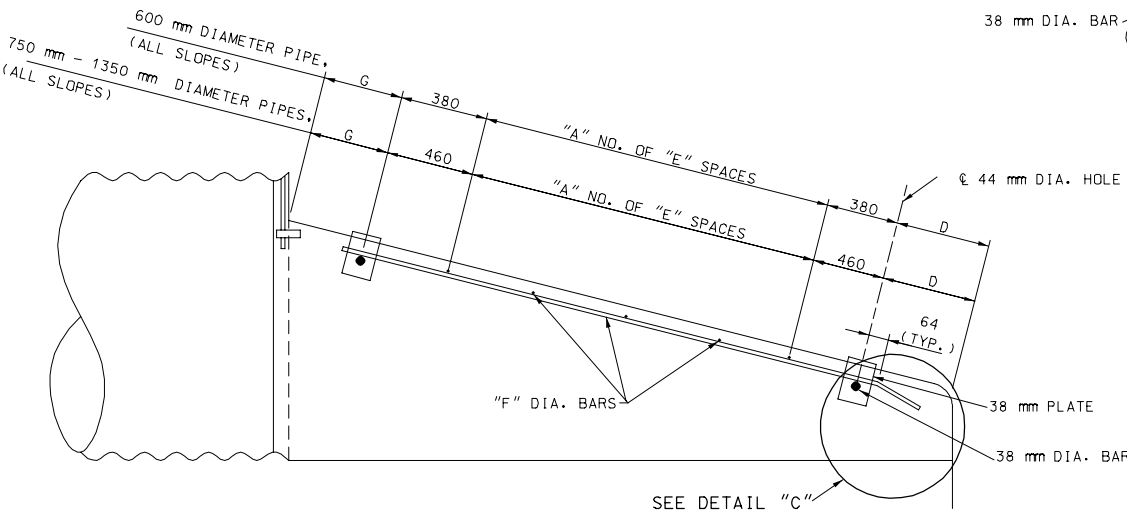
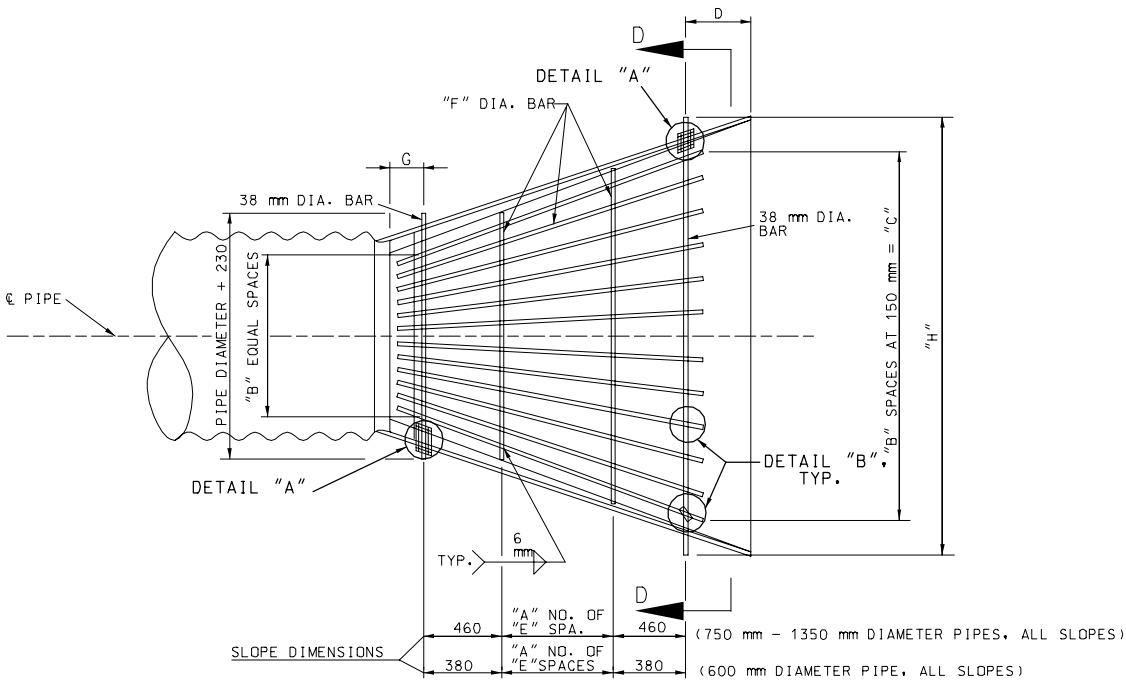
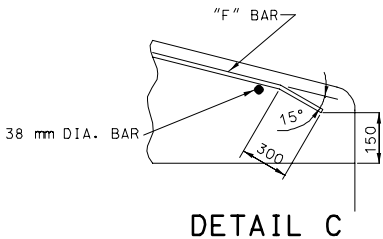
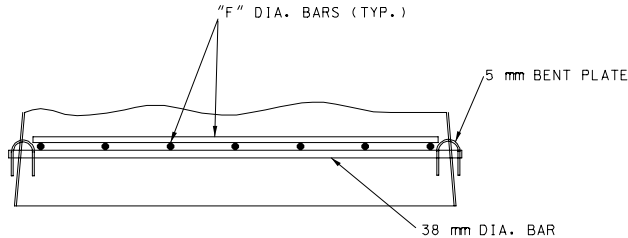
ALL 3 PIECE SKIRTS FOR 1500 mm PIPES SHALL HAVE 2.8 mm THICK SIDES AND 3.51 mm THICK BOTTOM (CENTER) PANELS. WIDTH OF BOTTOM PANELS SHALL BE GREATER THAN 20% OF THE PIPE PERIPHERY CONNECTOR SECTION. CORNER PLATES AND TOE PLATES SHALL BE GALVANIZED AND OF THE SAME OR GREATER THICKNESS AS THE SKIRT.

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION			
	SAFETY SLOPE END SECTION		
DATE: _____	EFFECTIVE: 07-01-2004	M732.10F	1 2

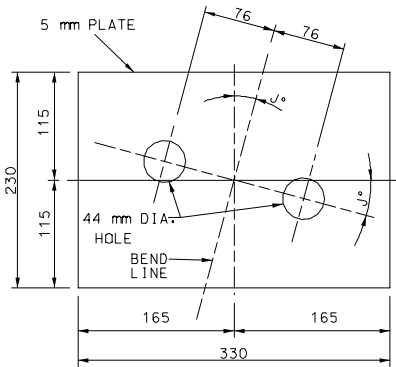
BAR GRATE SYSTEM DATA

DRAIN PIPE SIZE mm	1:3 SLOPE									1:4 SLOPE									1:6 SLOPE								
	A	B	C mm	D mm	E mm	"F" BARS mm DIA.	G mm	H mm	J	A	B	C mm	D mm	E mm	"F" BARS mm DIA.	G mm	H mm	J	A	B	C mm	D mm	E mm	"F" BARS mm DIA.	G mm	H mm	J
*375																											
*450																											
*525																											
600	0	4	600	150	380	16	209	991	18.4°	0	4	600	400	380	16	300	991	14°	2	4	600	333	380	16	300	991	9.5°
750	0	5	750	387	457	16	300	1143	18.4°	1	5	750	413	460	16	300	1143	14°	3	5	750	498	460	16	300	1143	9.5°
900	1	6	900	413	457	19	300	1295	18.4°	2	6	900	460	460	19	438	1285	14°	5	6	900	511	460	19	300	1295	9.5°
1050	2	7	1050	438	457	25	300	1448	18.4°	4	7	1050	300	460	25	300	1448	14°	7	7	1050	302	460	25	230	1448	10.1°
1200	3	8	1200	460	457	25	308	1600	18.4°	5	8	1200	460	460	25	321	1600	14°	7	8	1200	330	460	25	230	1600	11.9°
1350	4	9	1350	460	457	29	333	1753	18.4°	6	9	1350	460	460	29	492	1753	14°	7	9	1350	362	460	29	230	1753	13.7°

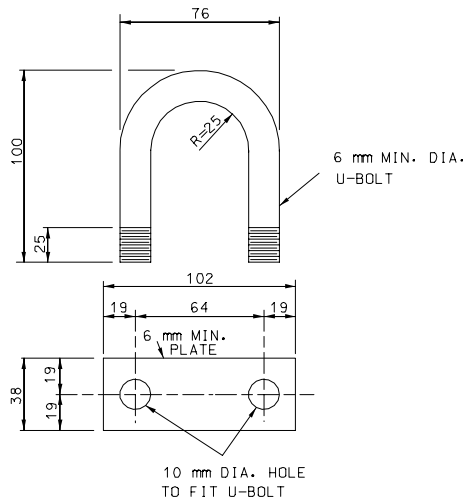
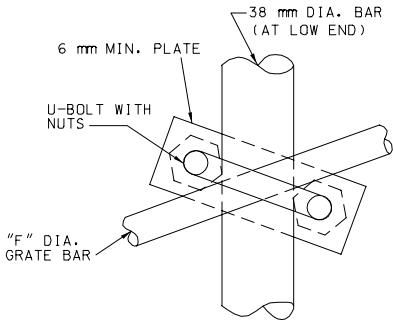
* BAR GRATE SYSTEM IS NOT REQUIRED FOR DRAIN PIPE DIAMETER OF 525 mm OR LESS, FOR SINGLE PIPE INSTALLATIONS.



DETAIL A
BENT PLATE ANCHOR



DETAIL B
U-BOLT ANCHOR



GENERAL NOTES:
ALL DIMENSIONS SHOWN ARE IN mm UNLESS OTHERWISE NOTED.
ALL STEEL MATERIAL FOR BAR GRATE SYSTEM SHALL BE IN ACCORDANCE WITH ASTM A575 GRADE 1020 STEEL.
ALL MATERIAL IN GRATE SYSTEM SHALL BE GALVANIZED.
GALVANIZING SHALL BE DONE IN ACCORDANCE WITH ASTM A123.
ALL MATERIALS, FABRICATION AND INSTALLATION OF OPTIONAL BAR GRATE SYSTEM USED IN LIEU OF SAFETY BAR SYSTEM SHALL BE INCLUDED IN CONTRACT UNIT PRICE BID FOR END SECTION (SAFETY SLOPE).

MISSOURI HIGHWAYS AND TRANSPORTATION
COMMISSION

OPTIONAL BAR GRATE
SYSTEM FOR SAFETY
SLOPE END SECTION

DATE: _____ EFFECTIVE: 07-01-2004 M732.10F 2/2